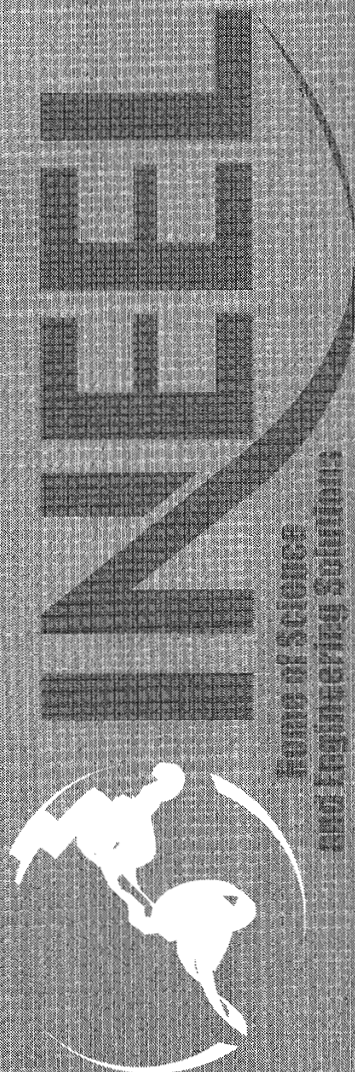


***Operable Unit 7-08, Organic  
Contamination in the Vadose Zone  
Environmental and Operational  
Mid-Year Data Report, 2002***

*Ryan McMurtrey  
September 2002*



*Idaho National Engineering and Environmental Laboratory  
Bechtel BWXT Idaho, LLC*

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September 2002

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Idaho Falls, Idaho 83415**

**Prepared for the  
U.S. Department of Energy  
Assistant Secretary for Environmental Management  
Under DOE Idaho Operations Office  
Contract DE-AC07-99ID13727**

# **Operable Unit 7-08, Organic Contamination in the Vadose Zone Environmental and Operational Mid-Year Data Report, 2002**

**INEEL/EXT-02-00981  
Revision 0**

**September 2002**

Approved by

*Lisa Harvego*

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WAG 7-08 Project Engineer

*9/20/02*

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Date

## **ABSTRACT**

Since January 1996, Operable Unit 7-08 has been using soil vapor extraction to remove organic contamination from the vadose zone outside the disposal pits and trenches in the Subsurface Disposal Area. The vadose zone contains volatile organic compounds, primarily in the form of organic vapors that have migrated from the buried waste in the pits and trenches.

This report documents the operational and sample data for operable unit 7-08 that was recorded between January 1, 2002, and June 30, 2002. During that time approximately 6,269 kg (13,820 lb) of total volatile organic compounds were removed from the vadose zone and oxidized through thermal or catalytic processes. Vapor Vacuum Extraction with Treatment Units A, B, and D removed approximately 3,069 kg (6,765 lb), 1,868 kg (4,119 lb), and 1,332 kg (2,936 lb), respectively.

Carbon tetrachloride is the largest contributor to the volatile organic compound mass removal with 57% of the total for this operating cycle. Isoconcentration plots of current carbon tetrachloride vapor data, at approximately the 21 m (70 ft) depth, indicate an overall decrease in the areal extent of the plume when compared to data taken before operations at the same depth. The data also suggest a decrease in the carbon tetrachloride concentration at the center of the plume.



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## ACRONYMS

B&K	Brüel and Kjær
DQO	data quality objective
GC	gas chromatograph
INEEL	Idaho National Engineering and Environmental Laboratory
OCVZ	organic contamination in the vadose zone
OU	operable unit
PM	preventive maintenance
RPD	relative percent difference
ROD	record of decision
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
VOC	volatile organic compound
VVET	vapor vacuum extraction with treatment





# **Environmental and Operational 2002 Midyear Data Report for Operable Unit 7-08**

## **1. INTRODUCTION**

### **1.1 Purpose**

This report documents the operational activities of Operable Unit (OU) 7-08 during the midyear reporting period of operations for calendar year 2002 (i.e., January 1, 2002, through June 30, 2002). OU 7-08 is defined as the organic contamination in the vadose zone (OCVZ) at the Subsurface Disposal Area (SDA) of the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL).

Operable Unit 7-08 extends from the land surface to the top of the Snake River Plain Aquifer approximately 177 m (580 ft) beneath the RWMC outside the disposal pits and trenches within the SDA. The vadose zone contains volatile organic compounds (VOCs) primarily in the form of organic vapors that have migrated from the buried waste in the SDA. Figures 1 and 2 are maps showing the locations of the RWMC and the SDA, respectively.

Operable Unit 7-08 is the designation recognized under the Federal Facility Agreement and Consent Order (DOE-ID 1991) and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (42 USC § 9601 et seq.) for OCVZ remediation beneath the RWMC, of which the SDA is a part. According to the OU 7-08 Record of Decision (ROD) (DOE-ID 1994), the selected remedy for OCVZ consists of the extraction and destruction of organic contaminant vapors present in the vadose zone and the monitoring of vadose zone vapors in the Snake River Plain Aquifer beneath and within the immediate vicinity of the RWMC.

To implement the selected remedy described in the OU 7-08 ROD, three vapor vacuum extraction with treatment (VVET) units with recuperative flameless thermal oxidation systems were installed within the boundaries of the SDA and began operating in January 1996. Two of the flameless thermal oxidation system units (designated as Units A and B) were designed to extract and treat vapors from two extraction wells each, and one flameless thermal oxidation system unit (designated as Unit C) was designed to extract and treat vapors from one extraction well. During the spring of 2001, Unit C was decommissioned and removed from the SDA and replaced with an electrically heated catalytic oxidizer (designated as Unit D) installed at the previous Unit C location. Currently, Unit A treats vapors from Extraction Well 8901D, Unit B treats vapors from Extraction Well 2E, and Unit D treats vapors from Extraction Well 7V.

### **1.2 Background**

To implement the selected remedy described in the OU 7-08 ROD, which was issued final on December 2, 1994, 15 new vapor extraction and monitoring wells were installed in, or adjacent to, the SDA during 1994. In addition, one extraction well, 8901D, and five monitoring wells, D02, 8801, 8902, 9301, and 9302, were incorporated for extracting and monitoring VOC vapors. In 2000, Wells DE-1 and M17S were installed to provide additional monitoring. Wells 6E and 7E were installed to provide extraction capability near source areas above 24 m (80 ft) below ground surface.

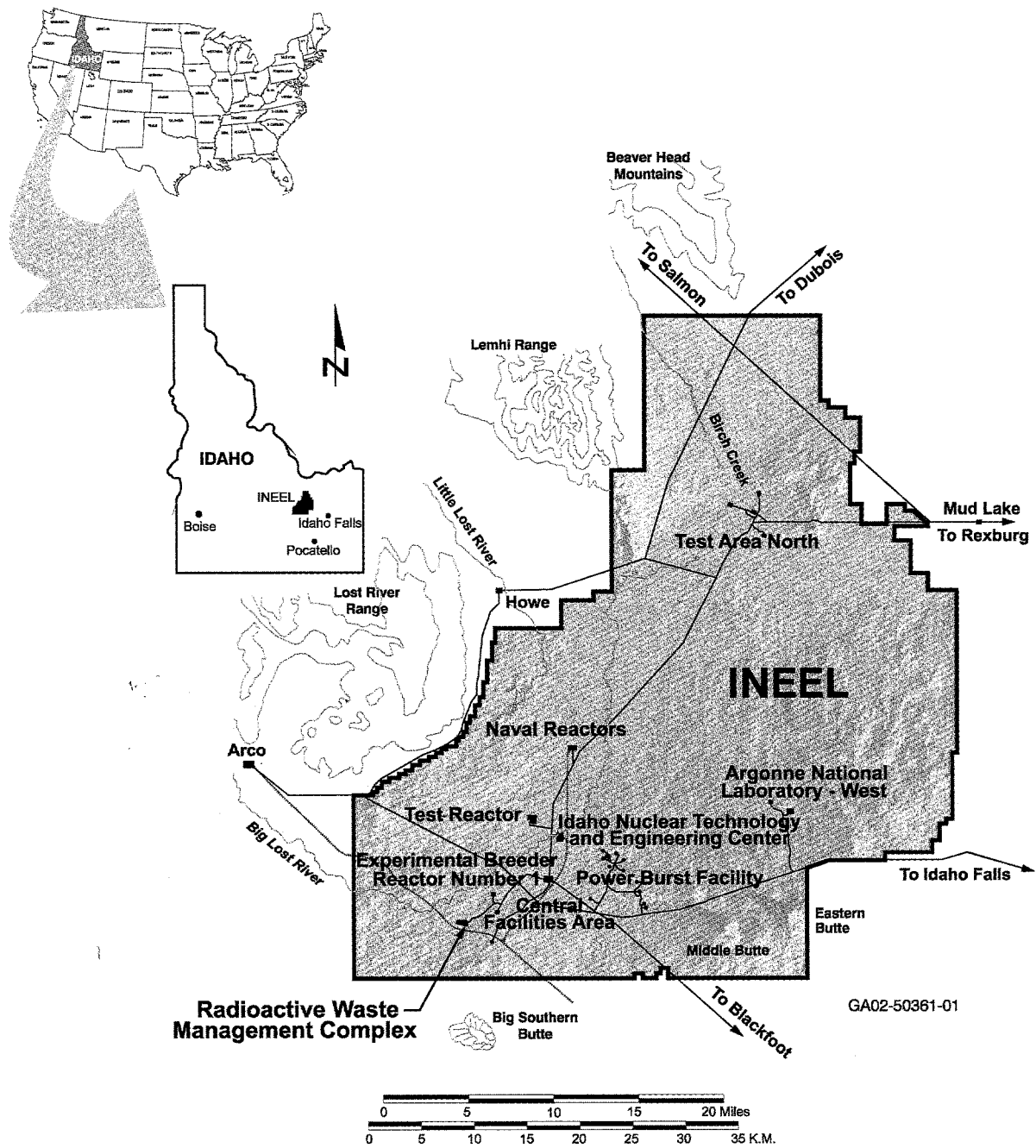


Figure 1. Map of the Idaho National Engineering and Environmental Laboratory showing the location of the Radioactive Waste Management Complex.

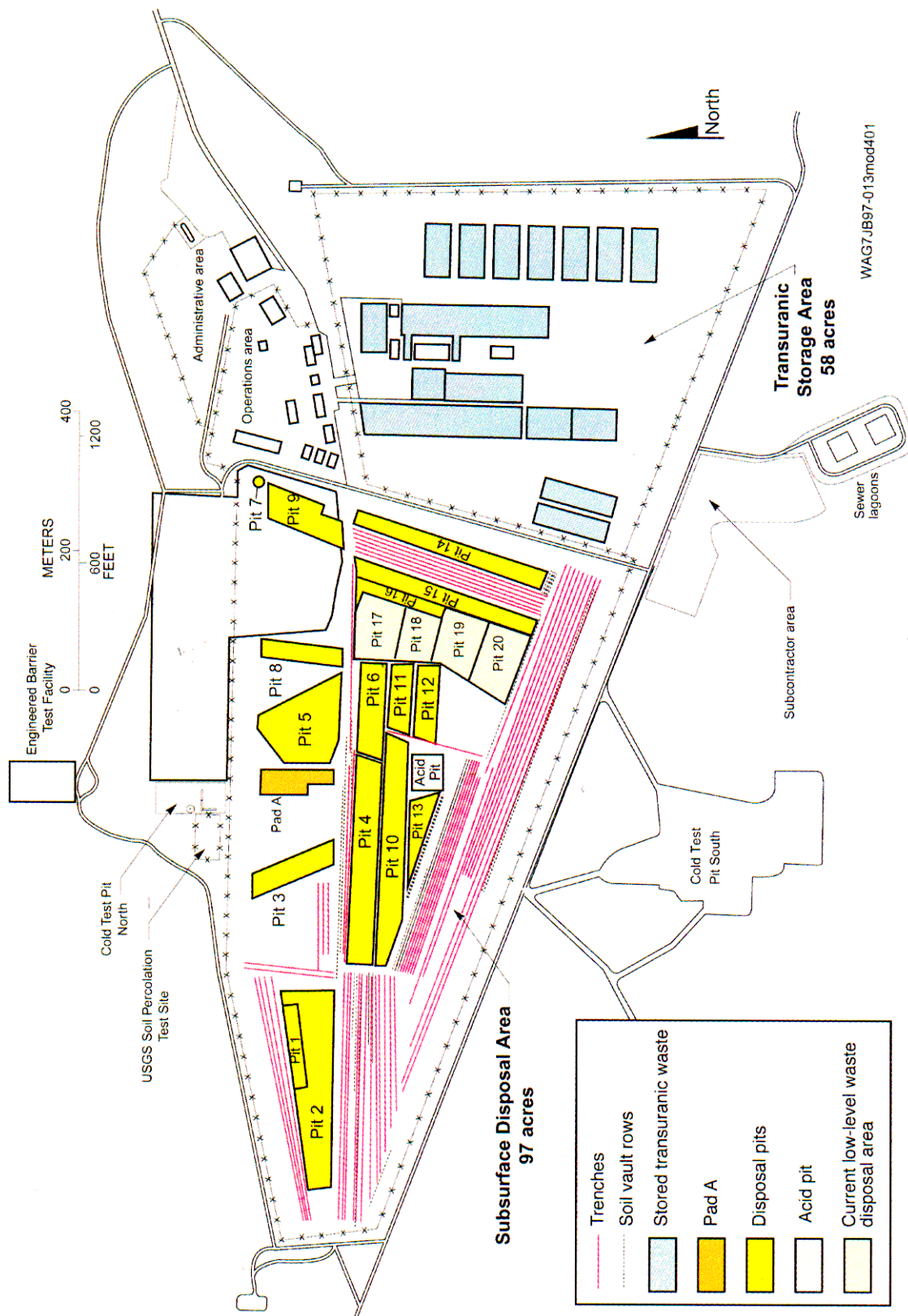


Figure 2. Map of the Radioactive Waste Management Complex showing the location of the Subsurface Disposal Area.

## 2. DISCUSSION OF ENVIRONMENTAL AND OPERATIONAL SAMPLE DATA

To calculate mass removal rates and to monitor the effectiveness of the VVET system, vapor samples are collected at the inlet of the VVET units and analyzed using a Brüel and Kjær (B&K) photoacoustic multi-gas analyzer. This section presents a discussion of the following data quality and monitoring objectives for the project:

- Precision
- Accuracy
- Completeness
- Comparability
- Mass removal
- System optimization and maintenance
- Spatial and temporal distribution of VOCs in the vadose zone.

### 2.1 Precision

Precision pertains to the sharpness, definition, or focus of a particular data set. Precision implies an exact measurement with little sample-to-sample variation and high repeatability. Two types of sample replicates were analyzed to ensure the quality of collected data. The two classifications of replicates were field splits and field duplicates. A field split is a repeat analysis of a field-collected sample used to test the precision of the analytical instrument. A field duplicate is a separate sample, field collected from the same location used to test the precision of the field collection techniques. Precision numbers were determined by calculating the relative percent difference (RPD) for both the field duplicates and the field splits. The RPD is calculated as shown in Equation (1) where  $C_1$  and  $C_2$  are the respective analyte concentrations in a replicate sample pair.

$$RPD = 100 \times \frac{(|C_1 - C_2|)}{\left(\frac{C_1 + C_2}{2}\right)} \quad (1)$$

Samples were analyzed, as in previous operating cycles, using a B&K gas analyzer. Concentrations of chloroform ( $\text{CHCl}_3$ ), 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride ( $\text{CCl}_4$ ), and total VOCs were recorded (see Appendix A). A total of 93 sample replicates (duplicate and split sample pairs) were collected during the operating cycle, resulting in a total of 465 possible component pairs. Sixty of the 93 sample replicate pairs exhibited RPDs of less than 30% (INEEL 2002) for all analyzed components. Of the 33 sample pairs that exceeded 30% RPD, 24 were the result of measured analyte concentrations (for one or more components) below the 1-ppmv B&K detection limit. The measurement precision decreases as sample concentrations approach the 1-ppmv detection limit of the B&K, resulting in the observed increase in RPD.

## 2.2 Accuracy

Accuracy pertains to the extent to which instrument readings approach the true values and are free from error. Instrument accuracy was tested using various sample standards before analyzing each sample set during the midyear 2002 operating period. Three standard gasses, 1.01 ppmv carbon tetrachloride, 100.5 ppmv carbon tetrachloride, and 998.8 ppmv carbon tetrachloride have been procured and are now analyzed before each sample set. Analytical results for the 1.01-ppmv standard sample were measured with reported concentrations ranging from 71 to 278% of the known concentration. Analytical results for 44% of the 1.01-ppmv standard samples exceed the prescribed acceptable  $\pm 20\%$  error bound limit. Analytical results for the 100.5-ppmv standard samples are much less scattered than those of the 1.01-ppmv standard, with results that range from 65 to 94% of the known concentration. This exceeds the prescribed acceptable  $\pm 20\%$  (INEEL 2002) error bound limit in 50% of the samples. Analytical results for 47% of 998.8-ppmv standard samples exceed the acceptable  $\pm 20\%$  error bound limit with results that range from 66 to 100% of the known concentration. A low bias to analytical results is observed above the 1.01-ppmv concentration level. After adjustment was made to the instrument pressure on April 2, 2002, (as discussed in Section 2.2.1.1), analytical results have fallen within the acceptable  $\pm 20\%$  error bound limit for all standard samples of  $\text{CCl}_4$ . The accuracy of the B&K is illustrated in Appendix B.

### 2.2.1 Analytical Performance Enhancement

The project has taken several steps to improve the quality of data collected and the confidence with which this data can be used. Included in these are improvement of sample handling and storage procedures, calibration and performance optimization of existing analytical equipment, and examination of alternative analytical techniques.

**2.2.1.1 *Brüel and Kjær Photoacoustic Gas Analyzer.*** Standards (i.e., premixed gas samples) were purchased at concentrations of 1 ppm, 100 ppm, and 1,000 ppm. Constituent concentrations of each of the standard gasses are detailed in Table 1. These standard gasses are analyzed before each set of vapor samples to quantify instrument performance.

Table 1. Standard gas compositions.

Constituent	1 ppm Standard	100 ppm Standard	1,000 ppm Standard
Chloroform	1.01 ppm	100.4 ppm	—
1,1,1-Trichloroethane	0.99 ppm	99.8 ppm	—
Tetrachloroethene	1.02 ppm	99.9 ppm	—
Trichloroethene	1.01 ppm	100.1 ppm	—
Carbon Tetrachloride	1.01 ppm	100.5 ppm	998.7 ppm

Through this analysis, the accuracy of the B&K was quantified, and determined to fall outside of the performance goals set in the OCVZ data quality objective (DQO) report (INEEL 2002). To improve analytical performance, the B&K was adjusted from approximately 848 millibar to 640 millibar before analysis of vapor samples on April 2, 2002. This adjustment modified the pressure used in calculation of VOC concentration by the B&K. The final pressure was selected through a trial and error approach in which an adjustment to pressure was made, a standard sample with known concentration was analyzed, and the concentrations reported by the instrument were compared to known standard concentrations. This process was repeated until the measured concentration was optimized as close to the known standard concentration as possible. Significant enhancement of the instrument performance was the result. Before April 2, 2002, 78% of all standard samples analyzed produced results that fell outside the DQO

(INEEL 2002) target for analytical accuracy. Subsequent to adjustment of instrument pressure, all standard sample analytical results for  $\text{CCl}_4$  have fallen within the  $\pm 20\%$  error bound specified by the OCVZ DQO. These results are shown in the figures in Appendix B.

**2.2.1.2 Gas Chromatography.** In an attempt to improve analytical accuracy, an effort was made to identify alternative analytical techniques that could be applied in the analysis of vapor samples. A gas chromatograph (GC), configured for direct vapor sampling and outfitted with a macro argon ionizing detector, was obtained and dedicated to the analysis of samples generated through OCVZ operations. Preliminary analysis results of 100 ppm and 10 ppm (produced by 10:1 dilution of the 100 ppm standard with ambient air) standard gasses indicated that the instrument performance would satisfy the project goals for precision and accuracy. The 1 ppm standard was not initially tested with the GC.

Through the process of performance validation, several deficiencies in the instrument design resulting in analytical error were identified. Included in these deficiencies were lack of temperature control in the sample and sample loop, lack of a circulation fan in the column oven, lack of an independent detector temperature control, and poor design of the sample loop and sample injection process train. These analytical instrument parameters are discussed in the following paragraphs.

Temperature control of the sample and sample loop is critical when a volumetric vapor sample is to be analyzed. Because vapor density is strongly affected by temperature, a minor change in temperature has a significant influence on the mass of sample contained in a controlled volume loop. Variation in vapor density can negatively influence both analytical accuracy and precision.

While not directly influencing analytical accuracy or precision, the lack of a circulation fan in the column oven may lead to uneven temperature distribution within the column oven. In the event of a temperature upset, the temperature may rise or fall from the set point, resulting in a shift of the analyte retention time on the chromatography column. This could lead to erroneous peak identification and analytical error in determining chemical concentration.

The macro argon ionizing detector is highly sensitive to temperature fluctuations. The detector response is optimized at a single discrete temperature. The voltage signal from the detector increases as this discrete temperature is approached from both above and below the optimum. It is critical that the temperature of the detector is precisely controlled at the desired set point (not necessarily the optimum response temperature) to minimize any analytical error associated with temperature fluctuation. In its current configuration, the detector receives indirect heat from the column oven and temperature control of the detector is imprecise. Direct heating of the detector would improve temperature control, reduce fluctuation, and improve performance of the macro argon ionizing detector, relative to data quality goals.

The sample loop is configured such that a sample is withdrawn from a Tedlar sample bag and drawn into the tubular sample loop by a compact vacuum pump. Solenoid valves are used to direct sample flow into the loop and through the chromatography column. The instrument is inconsistent in the sequence of valve closure and stoppage of the vacuum sample transfer pump. In the event that the valves close before the pump is fully stopped, the sample is captured under sub-ambient pressure and held for injection into the column. At sub-ambient pressure, a smaller mass of sample fills the loop than would be required at ambient pressure. Because of the reduced mass contained in the loop at sub-ambient pressure, the analyzed sample is unrepresentative of the actual bulk concentration.

Deficiencies in instrument design, as described above, resulted in inconsistent performance of the GC. Figure 3 illustrates instrument performance in analysis of samples at concentrations ranging from 1 to 100 ppm. For each of the analytes tested, the linearity of the detector response is poor across the range of 1 to 100 ppm. Values of  $R^2$  range from 0.6693 to 0.9144, where a value of 0.99 or better is desired. Because the detector response is nonlinear across the concentration range of interest, dilution of samples exceeding the upper concentration limit would be required to ensure accuracy of analytical results.

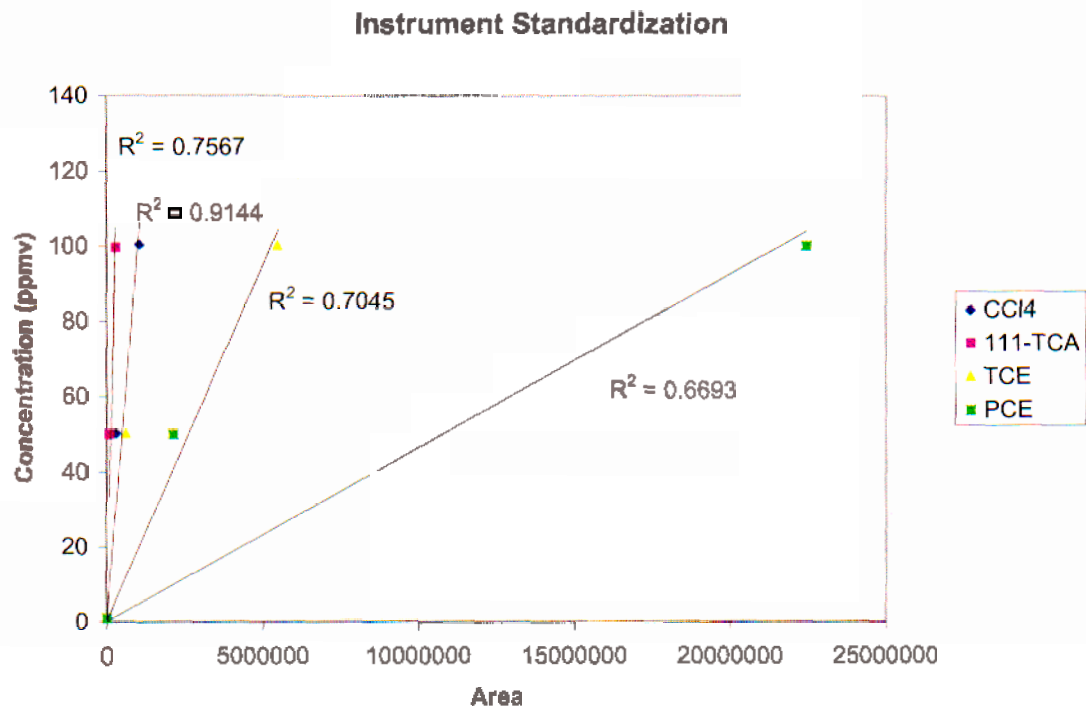


Figure 3. Gas chromatograph linearity.

Figure 4 illustrates the precision of the GC and the RPD encountered at concentrations ranging from 1 to 100 ppm. Figure 4 also illustrates that the RPD is expected to exceed the goal of 30% in samples at concentrations of less than 90 ppm. As such, it would be impracticable to dilute samples and improve instrument accuracy without sacrificing precision beyond acceptable levels.

The technical limitations of the GC, including temperature control and sampling configuration as described above, are believed to be unique to the instrument model. The project is evaluating other models, brands, and types of analytical instrumentation, including gas chromatographs and fourier transform infrared spectrometers, and will select an instrument that will meet the project goals for precision and accuracy. This instrument could be used to provide quality assurance and quality control of analytical vapor sample data.

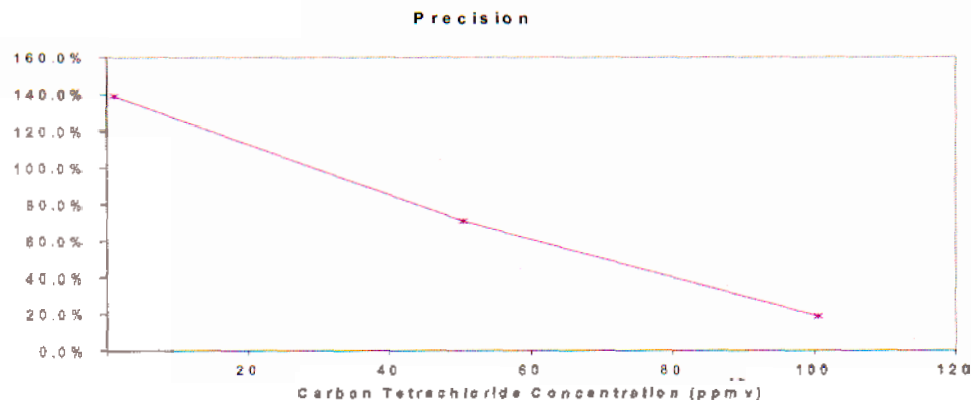


Figure 4. Gas chromatograph precision.



## 2.3 Completeness

A total of 720 vapor samples, including 38 duplicates, were targeted for collection during the past 6 months of operation. Ultimately, 637 samples were collected, including 35 duplicates. Splits and duplicates were targeted for analysis rates of at least 1:10 and 1:20, respectively. Percent completeness of the sampling and analytical data was calculated for this operating cycle using Equation (2). Completeness of sampling is detailed in Table 2 for monthly, duplicate, and repeat samples. Because samples are considered noncritical during VVET operations, a target for completeness of 90% is designated by the DQO report (INEEL 2002).

$$\%Complete = 100 \times \frac{\# \text{ Samples Collected}}{\# \text{ Samples Targeted}} \quad (2)$$

Table 2. Completeness of sampling.

	Samples Targeted	Samples Collected	Percent Complete
Monthly Samples	720	637	88%
Monthly Duplicates	38	35	92%
Monthly Splits (Repeats)	68	62	91%

## 2.4 Comparability

The data set included in this report (i.e., January 1, 2002 through June 30, 2002) is comparable to that of previous data sets because the same field collection technique, field procedures, sample handling methods, quality assurance and quality control procedures were applied. Analytical detection limits are similar because the same field instrumentation was used. Duplicate field samples were targeted for collection at a rate of roughly 5%, while field splits were targeted at a rate of 10%, in accordance with the OCVZ DQO report (INEEL 2002).

On a monthly basis, samples were collected from 99 vapor ports within and in the immediate vicinity of the SDA boundary to monitor concentration trends in the VOC plume. On a quarterly basis, 25 additional ports outside the SDA boundary were sampled to monitor the vapor concentrations at various locations ranging up to 9,100 ft from the VOC source area. Vapor port sampling and analysis is completed in accordance with the OCVZ DQO (INEEL 2002).

The statistical analyses for precision and accuracy of six monthly vapor port sampling events (January 2002 through June 2002) and two quarterly sampling events (March 2002 and June 2002) are included in this report.

## 2.5 Mass Removal

The VOC concentrations of process samples taken from ports on the inlet lines (downstream of the ambient air intake valves) to the VVET units were used to calculate mass removal rates. Samples are taken daily during the normal operations work week (i.e., Monday through Thursday) and the results are averaged between sampling events. The results show that approximately 6,269 kg (13,820 lb) of total VOCs were removed during this operating cycle. Units A, B, and D removed approximately 3,069 kg

(6,765 lb), 1,868 kg (4,119 lb), and 1,332 kg (2,936 lb), respectively. The actual operating hours and average daily unit operation parameters (i.e., flow rate, pressure, temperature) were used for the mass removal calculations (McMurtrey 2002).

Consistent with the analysis of the well vapor samples, process samples are analyzed using the B&K analyzer. As discussed in Section 2.2, the accuracy of the B&K exceeded the prescribed  $\pm 20\%$  (INEEL 2002) error bound during analysis completed before April 2, 2002. Therefore, the mass removal estimates prior to April 2, 2002 could have greater than  $\pm 20\%$  error. Since a low bias to the data was observed prior to April 2, 2002 when an adjustment to instrument pressure was made, VOC mass removal could be underestimated (80% of the true total for the period of January through March 2002). Based on analytical results, the accuracy of VOC mass removal estimation for the period of April to June 2002 is within the  $\pm 20\%$  error as specified by the OCVZ DQO report.

Appendix C provides the operations mass removal data. The analyte mass removal estimates during this reporting cycle for Units A, B, and D are presented in Appendix C Tables C-1, C-2, and C-3, respectively. Shown graphically in Figures C-1, C-2, and C-3 are process sample (i.e., inlet) carbon tetrachloride concentrations for Units A, B, and D, respectively. For comparison, Figures C-4 and C-5 graphically present the mass removal estimates for each analyte during this reporting cycle and since January 1996, respectively. Analyte mass removal estimates for each operating cycle since January 1996 are provided in Table C-4. As shown in this table, carbon tetrachloride is the largest contributor to the VOC mass removal with 57% of the total during January through June 2002 and 63% of the total since January 1996.

## **2.6 Spatial and Temporal Distribution of Carbon Tetrachloride in the Vadose Zone**

Spatial and temporal distribution of the carbon tetrachloride concentration in the subsurface is graphically presented in Appendix D. The figures represent a horizontal cross-section of the distribution of the carbon tetrachloride concentration in the SDA at approximately 70 feet below land surface. Concentration values for two specific days were used to prepare the plots, (1) before starting the remedial action on January 4, 1996, and (2) near the end of the midyear 2002 operating period on June 12, 2002. The carbon tetrachloride concentration distribution was kriged<sup>a</sup> by using the groundwater modeling system software program. Plots of current carbon tetrachloride vapor data, at approximately the 21 m (70 ft) depth, indicate an overall decrease in the areal extent of the plume when compared to data taken before operations at the same depth. The vapor data also indicate a decrease in the carbon tetrachloride concentration at the center of the plume.

## **2.7 System Optimization and Maintenance**

This section documents treatment system modifications, preventive maintenance, configuration management, and component calibration activities completed during January 2002 through June 2002. Preventative maintenance (PM) activities were completed in accordance with the OCVZ VVET PM schedule (McMurtrey and Harvego, 2001). The catalytic oxidizer, Unit D, operational shake down period was completed on March 4, 2002.

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a. Kriging is a method of linear regression that takes into account the spatial relationship of a series of points. In this case, concentrations are estimated between actual measured data points, providing insight into what the actual concentration profile might look like at any horizontal level in the contamination zone.

### **2.7.1 Unit D Operational Shake Down**

A catalytic oxidation system was purchased from King, Buck Technology of San Diego, California. This system, designated as Unit D, was installed at the SDA and tested following TPR-1764, "VVET Catalytic Unit Integrated Test." Project documentation, including safety analysis, testing and operating procedures, and a technician qualification program, was developed, reviewed, approved, and released for use. The U.S. Department of Energy (DOE), Idaho Department of Environmental Quality (IDEQ), and Environmental Protection Agency (EPA) conducted a pre-final inspection before full-scale operation began. The DOE, EPA, and IDEQ determined that the system was functioning properly and performing as designed. Following the on-site prefinal inspection, an operational shake down period for Unit D was initiated. The Pre-Final Inspection Checklist for VVET Unit D and notification of completion of the operational shake down period are included in Appendix E.

### **2.7.2 Unit D Heater Replacement**

In early Fall 2001 Unit D operation was interrupted due to low inlet temperature to the catalyst bed. The King, Buck Technology chief engineer performed an on-site inspection of the wiring at the terminal connections of the pre-heater. The electrical contacts on the heater were found to have disconnected on one of the two circuits (the results of excessive heat) limiting the output power of the heater to a maximum of 50% of design. It is assumed that the gasket failure in August 2001 contributed to excessive heat to the terminal box. The chief engineer recommended replacement of the heater with one of a slightly different design where the terminal housing is separated from the process flange by an air gap. Installation of the replacement heater was completed in early January 2002 and the continuous operational shake down period was restarted. All repair work was performed by King, Buck Technology personnel under warranty.

### **2.7.3 Units A and B Valve Replacement**

Aging process valves on Units A and B were replaced to enhance the reliability of operations. Valves and solenoids were replaced on both the vapor inlet and propane feed subsystems. New propane feed pressure regulators were installed. The propane vaporizers were taken off line, cleaned, and reinstalled. Nonfunctioning propane flow meters were removed from the process train.

### **2.7.4 Unit D Faulty Circuit Breaker Removal**

A faulty circuit breaker on the secondary side of the high voltage transformer which supplies power to Unit D interrupted system operation for the first time in February 2002 and then again in May 2002. In May, circuit breaker settings on the secondary side of the transformer were adjusted to coordinate the settings across multiple circuit breakers in series. Modeling of the circuit showed the Time Current Coordination curve for the main protective devices were not coordinated and that a fault on the system could cause any one of the devices to interrupt the current. The settings were adjusted to provide the system with the required NEC protection and allow for better coordination and Unit D was restarted in late May 2002. After a short period of operation, power loss was again experienced at Unit D. Power management, electrical engineers, and electricians isolated the problem to a faulty circuit breaker on the secondary side of the high voltage transformer. Engineers determined that the faulty circuit breaker was redundant and recommended removal. The circuit breaker was removed in June 2002. An older transformer, XFR-LP1, was also replaced at that time.

### **2.7.5 Unit B Well Connection**

The Unit B connection to Well 2E suffered from vapor condensation, freezing, and ultimately plugging during the Winter of 2002. The pipeline was disassembled, ice was removed, and the line was

reinstalled. A replacement line with integrated insulation and a heater to prevent condensation has been designed and construction is planned for Fall 2002. This type of well line will represent a prototype for future well connections.

#### **2.7.6 Removal of the Uninterruptable Power Supply**

Consistent with the reconfiguration of Unit A, the uninterruptable power supply on Unit B was replaced with an active tracking filter system. This change will improve the reliability and performance of the 110V data acquisition and control system of the oxidizer.

#### **2.7.7 Preventive Maintenance**

A preventive maintenance (PM) schedule has been developed to ensure that appropriate measures are taken to maximize the lifetime of system components. The PM schedule identifies maintenance activities that are to be completed on monthly, quarterly, semiannual, annual, and biannual intervals (McMurtrey and Harvego, 2001). The maintenance work is planned by the project field personnel and executed by RWMC craft personnel. Development and implementation of the PM work packages are in conformance with STD-101, "Integrated Work Control Process." Project field personnel continue to make improvements on the maintenance work packages to minimize downtime of the VVET units.

During the 2002 midyear reporting cycle, all PMs were performed on schedule. Monthly PMs were performed on Units A, B, and D from January 2002 to June 2002. Quarterly PMs were performed on Unit D in March 2002 and June 2002. Semi-annual and annual PMs were performed on Unit D in June 2002. The semi-annual PMs on Units A and B were performed in April 2002.

#### **2.7.8 Configuration Management**

The configuration management database has been updated to reflect the as-built Thermatrix units. All significant components of the Unit D oxidation system have been added to the configuration management database. The configuration management process provides quick access to a database of information regarding individual components and pieces of equipment, including the manufacturer model and serial numbers, contact address and phone numbers, and all pertinent information for repairing or replacing any component or part. The database also provides a numbering system to identify the equipment and components in the field when performing PM or other work activities.

#### **2.7.9 Calibration Program**

Calibration is performed on system process indicators in accordance with management control procedure (MCP) -2391, "Calibration Program". The process indicators including switches, gauges, transducers, and controllers, are calibrated to ensure proper function. Gauges, switches, and transducers are tested, calibrated, and retained in controlled storage at the RWMC prior to installation during scheduled PMs.

### **2.8 Operational Uptime**

During the midyear 2002 operations period, a 75% uptime goal was set for operation of the VVET units including planned downtime for maintenance activities. The goal of 6 weeks of continuous operation of Unit D was achieved on March 4, 2002. Units A, B, and D achieved uptimes of 94%, 99%, and 37% of available hours, respectively. Unit D suffered multiple shutdowns, as a result of the unreliability of the power supply to the system unrelated to operability of the catalytic oxidizer. VVET Units A, B, C, and D operations history is included in Appendix F.

## 2.8.1 Unplanned Downtime

Equipment failures that led to equipment shutdown are itemized in this section.

February 2 through 6, 2002

Unit D shut down as the result of a breaker trip in the transformer. Power management reset the breaker and the system was restarted on February 6, 2002.

February 8 through 9, 2002

Units A and B shut down on February 8, 2002. The propane pilot light at Unit A went out, apparently because of blowing and drifting snow. Unit B shut down because of high propane pressure. Both units were restarted on February 9, 2002.

February 19 through 20, 2002

Operation of Unit B was interrupted on February 19, 2002, to disconnect the vapor pipeline. Approximately 6 ft. of ice was inside the flex line and piping downstream of the well head connection, inhibiting vapor flow. Unit B was restarted on February 20, 2002. Flow conditions indicated that there was another obstruction in the pipeline. Unit B was kept running to prevent components freezing.

February 24 through 27, 2002

Unit A operation was interrupted on February 24, 2002, when high winds blew out the vaporizer pilot light. Attempts to restart the system revealed that the vaporizer thermostat was not functioning correctly. Suburban Propane replaced the thermostat and Unit A was restarted on February 27, 2002.

March 4 through 7, 2002

Unit B was shut down on March 4, 2002, to remove and clear ice from the well piping. The piping was reinstalled and Unit B was restarted on March 6, 2002. Flow conditions indicated that yet another section of piping was plugged. The pipefitter was able to work the ice out of the pipe without removing the section. On March 7, 2002, Unit B well piping was cleared and vapor extraction resumed from the well.

March 10 through 28, 2002

Unit A went down on March 10, 2002, as the result of failure of pressure switch PSHH-222. During startup on March 18, 2002, a “pop” sound was heard, power to the control panel was lost, and a “burned” odor was present for a short period. Work control was completed and electricians were made available on March 20, 2002, to troubleshoot the electrical problem. Troubleshooting revealed at least one blown fuse and damage to the fuse block for fuse FR2-L1 and fuse block FR2-002, which is connected to the emergency shutdown circuit. RWMC electricians completed the 15 amp FR2-L1 fuse replacement and fuse block replacement on March 27, 2002. Unit A was restarted on March 28, 2002.

April 14 through 18, 2002

Units A and B were shut down because of extreme weather conditions at the SDA. The area experienced winds nearing 100 mph and heavy snowfall. Power was lost completely to Unit B on April 14, 2002. On April 15, 2002, Unit A went down because of low propane pressure after the pilot light on the vaporizer was blown out. Unit A was restarted on April 15, 2002. High winds again caused the pilot light on the propane

vaporizer to blow out on April 17, 2002; however, Unit A was restarted later in the day.

On April 15, 2002, RWMC electricians performed limited electrical troubleshooting at Unit B. Power Management linemen replaced a blown fuse at the main power pole and restored power to Unit B on April 16, 2002. The Unit B air compressor motor starter had failed. The motor starter was repaired and Unit B was restarted on April 18, 2002.

#### April 19 through 23, 2002

Poor weather conditions once again caused operational downtime for all three VVET units. Unit A operation was interrupted on April 19, 2002, when high winds blew out the vaporizer pilot light. Unit A was restarted on April 20, 2002. High winds on April 23, 2002, caused multiple, brief power outages, which disrupted operation of Units B and D.

#### April 23 through May 8, 2002

On April 23, 2002, Unit A was shut down for performance of the semiannual preventive maintenance, replacement of the process vapor line flow gauge and maintenance on the vaporizer. All of the planned work was completed by close of business on April 25, 2002, except for reconnecting the vaporizer piping and releasing the lockout/tagout. The vaporizer was reconnected, the lockout/tagout released, and power restored to Unit A on April 29, 2002. When power was restored to Unit A, one thermocouple was nonfunctioning and required replacement. Work was expedited and the field team was able to get the thermocouple replaced by close of business. Upon restart, the burner failed to ignite. The burner was removed, pilot light cleaned, and the unit was restarted on May 8, 2002.

#### May 28 through 30, 2002

On May 28, 2002, the circuit breaker settings on the transformer that supplies power to Unit D were adjusted. Power was restored to Unit D and restart was attempted. The well line flow transmitter failed. It was replaced and Unit D was restarted on May 30, 2002.

#### June 12 through 13, 2002

Work was completed on June 12, 2002, to remove the faulty circuit breaker on the secondary side of the Unit D transformer (XFR-1000). An older transformer, XFR-LP1, was also replaced. Unit A was taken offline because a power outage was required to perform the electrical work. Units A and D were restarted on June 13, 2002.

#### June 16 through 30, 2002

Operation of Unit B was interrupted on June 16, 2002, when the RWMC offshift surveillance identified problems with the propane vaporizer. Suburban Propane performed limited troubleshooting and removed the vaporizer for servicing.

### **3. CONCLUSION**

Data quality and monitoring objectives include completeness, precision, and accuracy as outlined in the OCVZ DQO report (INEEL 2002). Targets for completeness and accuracy were generally met. Instrument analytical precision persists as a data quality concern and has yet to be resolved. To date, Units A, B, and D are operating and removing VOC mass from the RWMC subsurface. According to samples collected from various locations around the SDA, VOC concentrations are decreasing above the 34-m (110-ft) interbed.

## 4. REFERENCES

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